A Comprehensive Inpatient Discharge System

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Our group has developed a computer system that supports all phases of the inpatient discharge process. The system fills in most of the physician's discharge order form and the nurse's discharge abstract, using information available from sign-out, order entry, scheduling, and other databases. It supplies information for referrals to outside institutions, and provides a variety of instruction materials for patients. Discharge forms can be completed in advance, so that the patient is not waiting for final paperwork. Physicians and nurses can work on their components independently, rather than in series. Response to the system has been very favorable.

INTRODUCTION

The Brigham Integrated Computing System (BICS) is a large PC-based client-server hospital information system supporting Brigham and Women's Hospital (BWH), an urban tertiary care center in Boston. BICS features a number of advanced clinical applications, including provider order entry[1] for all orders on adult inpatients. Order entry has provided enhanced data capture, care guidance, and communication for inpatients. However, prior to the current project, the various forms and processes surrounding the discharge order were not computerized.

The written discharge procedure was for the physician to complete the discharge summary form, and a form for any necessary referral. After the physician finished, the nurse began writing the patient's discharge instruction sheet by copying the same or similar information. When this process was complete, the secretary began the transcription process. This process was prone to transcription errors and redundant efforts. Papers were lost, torn, unreadable, and sometimes hastily written as the patient was walking out the door, or even after the patient left the hospital. The medical record copy was a carbon that was difficult to read. Outside agencies that were to care for the patient post-hospitalization were faxed a document that was often impossible to read. If a patient telephoned the nurse with questions, or if an ancillary department required information about the discharge summary and instructions, the nurse had to request the medical record.

It appeared clear that a computer program could eliminate some of these redundancies and transcription errors. Additionally, the computer could provide added value by intelligently supplying likely answers to many of the fields on the discharge order and instructions. Thus, the order entry development team set to work on a discharge system with the following goals:

1) The system should support both the doctor's order form and the nurse's instruction work. The system should also facilitate referrals to post-discharge care.

2) The discharge orders and instructions should be available on BICS at all times, for the information of other clinical users.

3) Where possible, information already stored on BICS should be used to provide initial answers to discharge-form questions, or to assist the clinicians in providing these answers..

4) The system should identify insurance-regulation requirements, where they could affect the discharge form entries.

5) Because the general layout of the paper discharge order form was well accepted, the computerized process should mimic this form unless a new layout in a particular area would produce a direct advantage.

6) The system should encourage the physician to complete the orders in a timely fashion, so the patient is not waiting for paperwork.

7) The nurse should be able to start the instruction form before the physician's order has been finalized; any subsequent changes on the physician's order should be reconfirmed by the nurse.

The average length of stay for a patient at BWH is 5.35 days. There are approximately 2800 admissions to the hospital each month. In view of this large volume of patients moving in and out of the hospital, the design strategy for the discharge ordering process needed to be efficient and simple.

A team of physicians, nurses, nursing information systems specialists, programmers, and continuing-care

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workers worked together to design and develop the discharge system, which has been in operation since 1994.

PREVIOUS WORK

There have been a number of efforts to reduce the administrative burden of the discharge process, and to help guide providers toward optimal discharge plans. Sands[2] developed a program to guide physicians in writing discharge medications. That system offered educational material for patients, and sent electronic notification of new medications to the primary care provider (PCP).

Other efforts have been directed toward compiling discharge summaries from database information[3]; many of these take individual data items and build narrative text around them. Still other systems have used inpatient data to make inferences to guide discharge planning[4] or to compile a referral form[5]. In our development, we tried to take the best features of these, and enhance them to make a comprehensive package that would assist providers in nearly all aspects of the discharge process.

FEATURES

The BWH discharge order system consists of two major components: the doctors discharge order program, and the nursing instruction program. Both of these components feed into print programs that provide hard copies in a format similar to the familiar paper discharge forms.

Physician's section

The discharge order program (Fig. 1) used by the physician is available from the main order entry menu. A contingency field enables the physician to write the discharge orders in advance.

The form displays clinical information crucial to the discharge order. Since all adult inpatient orders are currently written on-line, the discharge system can pull in the patient's most recent orders. One example is the ordering of discharge medications. When prescribing medications for discharge, the physician views the complete list of medications that the patient is currently receiving. With a few keystrokes, the doctor may choose to discontinue or continue medications upon discharge. If the doctor continues a parenteral medication, the system automatically prompts the doctor with an option to change the route to PO, when applicable (sometimes this involves a suggested change in dose or even a change in the actual medication). The doctor can also add new medications for discharge; these are routinely checked for patient allergies, conflicts and food/drug interactions.

Other fields utilize information from other parts of the BICS database; these may include standing orders for diet, activity, and wound care. The doctor can pull the interim summaries from the Sign-Out system[6] directly

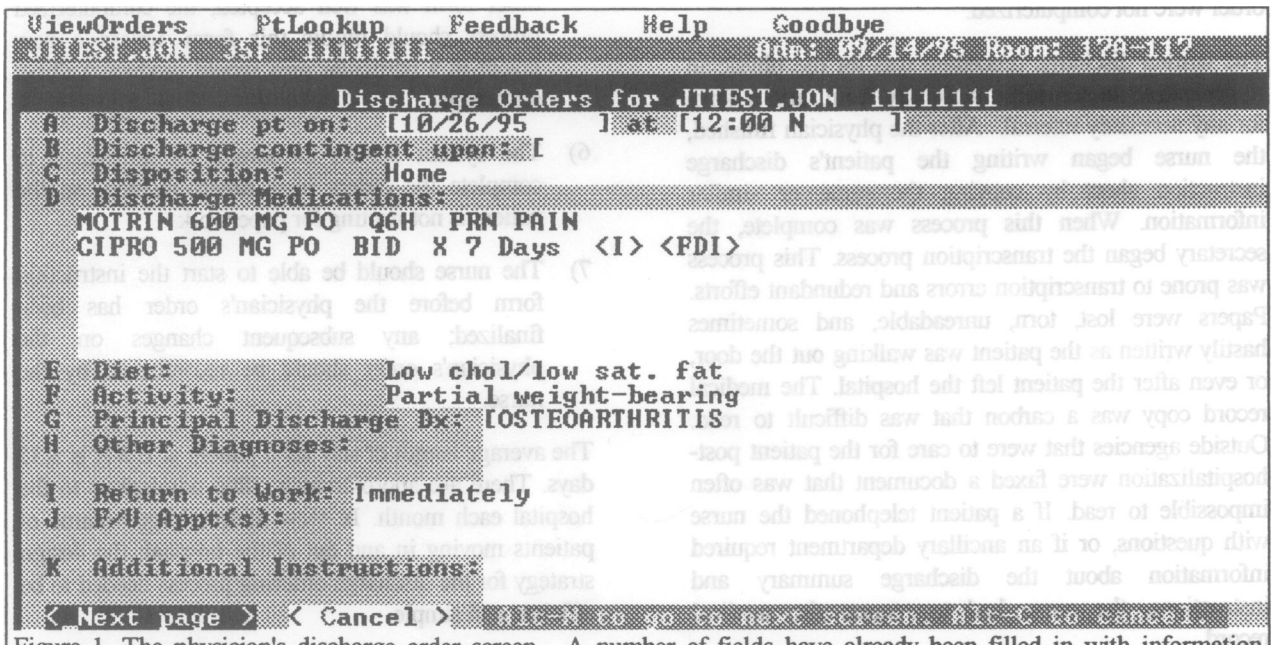


Figure 1. The physician's discharge order screen. A number of fields have already been filled in with information extracted from BICS.

into the discharge abstract. Operative procedures are also automatically transferred into the discharge form. In the case of births, information from the BICS labor and delivery system fill in the type of delivery, Apgar scores, etc. Whenever possible, physicians may choose from standardized lists of options. In all areas, the clinician has the option of adding additional information to the various fields.

Since there can only be one discharge order per patient per admission on-line, the physician can write the discharge orders in advance, when discharge is expected soon, and easily edit the orders later (if the patient has not yet actually been discharged) to reflect changes in the patient's status. The discharge orders can even be started during the admission, as happens during admissions for normal vaginal delivery. Furthermore, the BWH discharge system also provides medical students the opportunity to enter discharge orders. The nursing staff does not see these orders until they have been reviewed and /or edited by a physician.

Having the discharge orders on-line allows the physician to view a previous discharge order with ease, providing the clinician with pertinent information if a patient is readmitted to the hospital.

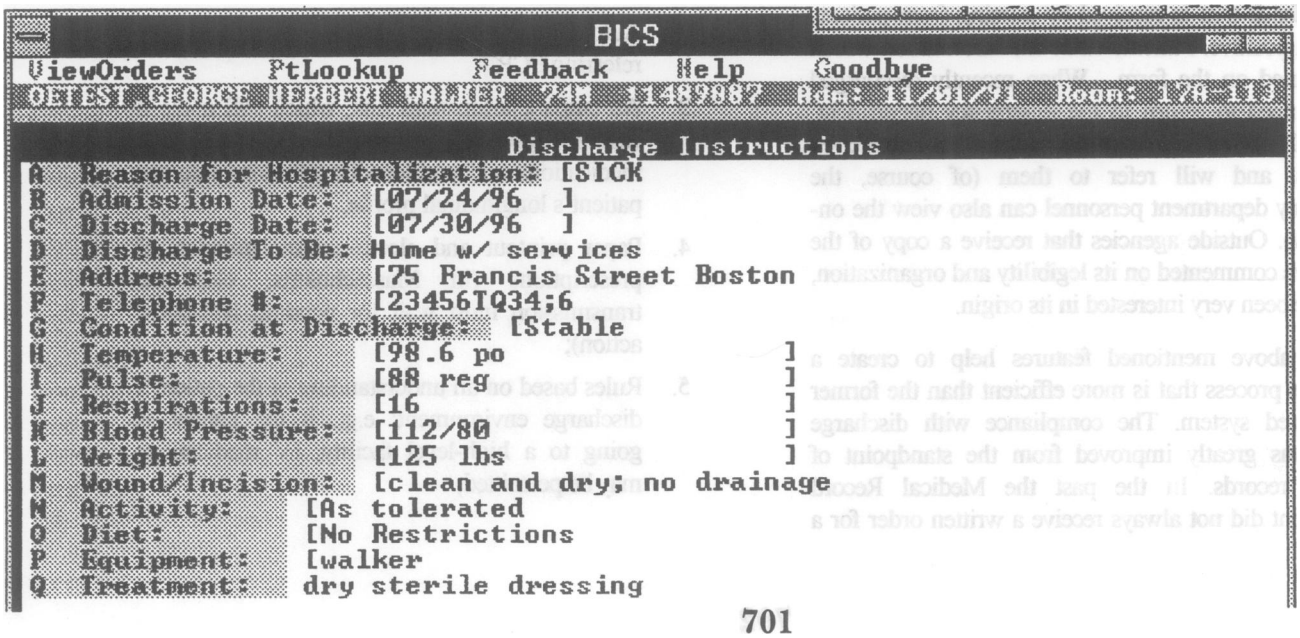
When the physician signs the discharge order, the computer displays a list of quality-of-care questions. These questions ask the doctor if the patient had a wound infection, or if a transfer to a special-care unit was unexpected -- information that is difficult to glean from other data. The doctor answers these as part of the data-gathering process for the hospital's quality improvement program.

Nurse's section

Upon completion, the discharge orders appear to the nursing staff via the status monitors located on each inpatient unit. These monitors list all patients on the unit, along with flags showing alerts and order status. When the doctor has completed the initial discharge orders, the nurse can begin the nursing portion of the discharge process. If the doctor edits the order later, the monitor will inform the nurse of the new changes, and will allow the nurse to edit the instructions correspondingly.

The nurse's subsystem interacts with the physician's orders in several ways to help to provide a continuum of care. By utilizing previously entered information, the form reduces the amount of new entry that the nurse must make. Many fields in the nursing instruction sheet are pre-filled from the physician's order. Some examples of pre-filled fields are the name and numbers of the patient's primary care physician, medical resident, case manager, physical therapist, and primary nurse. The nurse can select from a "watch for" list of common symptoms that might warrant medical intervention; instructions about these are included for the patient's use. Additionally, service-specific templates allow a department to set up, in advance, standard instructions regarding diet and activity. These are copied into the discharge instruction sheet upon request.

When the physician's orders read through to the nursing instruction sheet, the nurse sees these orders in a reorganized fashion appropriate for instructions. Medication orders are translated from jargon ("1 cap PO bid") into language that is easily understood by the patient. The nurse can edit or augment the instructions for additional clarity and customization. There is an



area to indicate if prescriptions have been given to the patient, thereby reducing the chance of discharging the patient without the necessary prescriptions. Shortly, prescriptions will be printed automatically from the instructions, eliminating a further step.

Apart from the on-line record of the forms, a number of printouts result from the discharge entries. These include a printed discharge-order sheet, the full set of nursing instructions, a medication chart, specific instructions for each medication (Fig. 2), and a form for the patient to sign indicating receipt of the material. The printed nursing instructions include additional information about vital signs, special instructions about wound care and when to call the physician, as well as some information about the in-house providers who cared for the patient. The nurse may print medication instructions (from the Medicom drug database) in English and Spanish.

IMPLEMENTATION AND USE

The complexity of implementation for the nurses' discharge instruction sheet was underestimated. The paper form had been so frequently used by nursing, that the change in practice affected their initial ability to use the automated version. Training sessions were used before implementation to educate the nursing staff about the form. The physician's form is less complex, and thus physician training was less formal, primarily consisting of presentations to the physicians' regular meetings. Nursing information systems specialists were on call during the first weeks for any questions the nurses or physicians might have about the form. After the initial change and learning period passed, the automated system was well received.

The feedback that is received by nursing from patients has been positive. Patients value the information which is contained on the form. When recently discharged patients need to return to the emergency department, they will often carry their discharge instruction printouts, and will refer to them (of course, the emergency department personnel can also view the on-line copy). Outside agencies that receive a copy of the form have commented on its legibility and organization, and have been very interested in its origin.

All the above mentioned features help to create a discharge process that is more efficient than the former paper-based system. The compliance with discharge orders was greatly improved from the standpoint of medical records. In the past the Medical Record department did not always receive a written order for a patietns discharge from the hospital. Additional features are in progress that will enable case managers to facilitate patient care referrals.

FUTURE DEVELOPMENTS

The discharge program was designed to help the physician and nurse through all of the steps of the discharge process. Planned enhancements will continue this support, and accommodate the new rules and processes that are now part of health care reality.

We are developing a comprehensive home-care referral system that will work in conjunction with the discharge order system. Information from the discharge order will complete most of the physician portion of the referral, further reducing the duplication of effort. Nurses, physical therapists, occupational therapists and social workers will be able to enter the required information for the patient care referral. Features will include an automatic screening for agencies that offer the ordered services in the patient's geographic area.

A feedback mechanism will help to build a patient satisfaction index for the list of agencies, thereby creating a database of perceived quality of home care agencies. Electronic transfer of the information will help ensure that timely services are given with minimal patient intervention. Other enhancements are designed to give further support to the primary care physician who will be managing the patient after discharge. Enhancements include:

1. Payor-specific rules; these include favored drugs (one payor may prefer one H2-blocking agent over another for cost reasons), and payor-based benefits such as home IV services;
2. Automatic messages and summaries to the referring PCP.
3. An outpatient/inpatient link, which will make it easy for the PCP to integrate the discharge medications and problem-list additions into the patient's longitudinal profile;
4. Paper printout and electronic transmission of prescriptions (in Massachusetts, electronic transmission must wait for pending legislative action);
5. Rules based on an understanding of the patient's discharge environment: e.g., if the patient is going to a high-level facility, IV medications may be permitted;

6. Automatic construction of discharge summaries. This requires capture of text and data from the BICS inpatient Sign-Out summaries, procedure and treatment data, and various major results;
7. Automatic creation and transmission of the referral form to a skilled nursing facility.

CONCLUSIONS

Using the available data from the BICS Order Entry, ADT, and Sign-Out systems, we have developed a discharge application which fills in much of the information needed for a discharge order, guides physicians in choosing discharge medications, and prepares general discharge and medication instructions for the patient. The system encourages physicians to enter discharge orders in a timely fashion, and reduces re-work on the part of the nursing staff. Both physicians and nurses benefit from the time saving features this system provides. Easy access to the forms and clinical information improve the workflow. Patients also benefit from the clear, concise printed instructions that are provided by the system. The system is now very well accepted, and can be further enhanced to support even more of the discharge process.

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